

## CLAIMS

What is claimed is:

- 1    1.    A method for manufacturing a magnetoresistive sensor comprising:  
2        providing a substrate:  
3        forming a photoresist mask over a desired sensor area  
4        depositing a magnetic hard bias material;  
5        removing said photoresist mask;  
6        depositing a plurality of sensor layers as full film layers; and  
7        chemical mechanical polishing sufficiently to remove portions of said sensor  
8                layers formed outside said sensor area.
  
- 1    2.    A method as in claim 1 wherein said plurality of sensor layers includes a free  
2    layer, said method further comprising:  
3        before forming said photoresist mask and before depositing said hard bias  
4        material, depositing a dielectric material of such a thickness that said hard bias  
5        material will align with said free layer.

1 3. A method as in claim 2 further comprising, after removing said photoresist mask,  
2 performing a material removal process to remove portions of said dielectric material not  
3 covered by said hard magnetic material.

1 4. A method as in claim 2 further comprising, after removing said photoresist mask,  
2 performing a reactive ion etch (RIE).

1 5. A method as in claim 2, wherein said dielectric material comprises SiO<sub>2</sub>.

1 6. A method as in claim 1, wherein said substrate is a magnetic, electrically  
2 conductive material.

1 7. A method as in claim 1, further comprising, after depositing said hard magnetic  
2 material, depositing an electrically insulating material.

1 8. A method as in claim 1, further comprising, after removing said photoresist mask,  
2 depositing a dielectric material, and then performing a reactive ion etch to remove  
3 horizontally disposed portions of said dielectric material.

1 9. A method as in claim 8 wherein said dielectric material comprises SiO<sub>2</sub>.

1 10. A method of manufacturing a current perpendicular to plane (CPP)  
2 magnetoresistive sensor, comprising:  
3 forming a first electrode;  
4 depositing a first full film layer of electrically insulating material onto said first  
5 electrode;  
6 forming a photoresist mask over a desired sensor area;  
7 depositing an electrically conductive seed layer;  
8 electroplating a magnetic, high coercivity hard bias material onto said seed layer;  
9 depositing a second electrically insulating layer;  
10 removing said photoresist mask;  
11 depositing SiO<sub>2</sub>, conformally to cover horizontal and non-horizontal surfaces;  
12 perform a reactive ion etch (RIE).  
13 depositing a plurality of full film sensor layers;  
14 performing a chemical mechanical polishing (CMP) process; and  
15 depositing a second electrode

1 11. A method of manufacturing a magnetoresistive sensor, comprising:  
2 providing a substrate;  
3 forming a photoresist mask in a sensor area, said mask having first and second  
4 laterally opposed sides;  
5 depositing a magnetic material, at least a portion of said magnetic material  
6 defining first and second magnetic layers extending from said laterally opposed  
7 sides of said mask;

8 removing said photoresist mask to define a trench between said first and second  
9 magnetic layers; and  
10 depositing sensor material layers, at least a portion of said sensor material layers  
11 being deposited in said trench.

1 12. A method as in claim 11 further comprising, after depositing said sensor material  
2 layers, performing a chemical mechanical polishing process to removed portions  
3 of said sensor material disposed outside of said trench.

1 13. A method as in claim 12 further comprising, after depositing said magnetic  
2 material, depositing a physically hard insulating material layer.

1 14. A method as in claim 13 wherein said physically hard insulating material layer is  
2 alumina ( $\text{Al}_2\text{O}_3$ ).

1 15. A method as in claim 13 wherein said physically hard insulating material layer is  
2 diamond like carbon (DLC).

1 16. A method as in claim 13, wherein said physically hard insulating material layer is  
2  $\text{SiO}_2$ .

1 17. A method for manufacturing a magnetoresistive sensor, comprising:  
2 providing a first electrode having an upper surface;

3        depositing a layer first layer of SiO<sub>2</sub> onto said upper surface of said electrode;  
4        forming a photoresist mask on said first layer of SiO<sub>2</sub>;  
5        depositing an electrically conductive seed layer;  
6        depositing a high coercivity magnetic material onto said seed layer;  
7        depositing a physically hard insulating material;  
8        depositing a second layer of SiO<sub>2</sub>;  
9        performing a reactive ion etch process;  
10       depositing sensor material layers;  
11       perform a chemical mechanical polishing process; and  
12       depositing an electrically conductive material to form a second electrode.

1    18.    A magnetic head comprising:  
2        a first electrode;  
3        a magnetoresistive sensor having first and second laterally opposed sides  
4        a and formed upon said first electrode'  
5        first and second electrically insulating walls formed at said first and second sides  
6                of said sensor;  
7        first and magnetic hard bias layers extending laterally outward from said first and  
8                second walls;  
9        first and second physically hard electrically insulating layers formed over said  
10        first and second hard bias layers; and

11           a second electrode formed over said sensor and said physically hard electrically  
12           insulating layers.

1    19.    A magnetic head as in claim 18, wherein said physically hard electrically  
2    insulating layers comprise alumina ( $\text{Al}_2\text{O}_3$ ).

1    20.    A magnetic data memory system, comprising:  
2           magnetic disk;  
3           a motor connected with said disk rotating said disk;  
4           a slider;  
5           an actuator connected with said slider to position said slider adjacent said disk;  
6           a magnetic sensor connected with said slider, said sensor comprising:  
7                a first electrode;  
8                a magnetoresistive sensor having first and second laterally opposed sides  
9                a and formed upon said first electrode'  
10          first and second electrically insulating walls formed at said first and  
11          second sides of said sensor;  
12          first and magnetic hard bias layers extending laterally outward from said  
13          first and second walls;  
14          first and second physically hard electrically insulating layers formed over  
15          said first and second hard bias layers; and  
16          a second electrode formed over said sensor and said physically hard  
17          electrically insulating layers.